

# 1 CLAIMS

2 What is claimed is:

3 1. A resonant optical modulator assembly, comprising:

- 4 a. an alignment housing, the housing including a waveguide-alignment groove and a  
5 resonator alignment groove;
- 6 b. a transmission optical waveguide, the waveguide being positioned within the waveguide  
7 alignment groove and secured to the alignment housing, the transmission optical  
8 waveguide being arranged for transmitting therethrough an optical signal carried by a  
9 waveguide optical mode, the transmission optical waveguide also having an evanescent  
10 optical coupling segment;
- 11 c. a resonator, the resonator positioned within the resonator alignment groove and secured  
12 to the alignment device, the resonator being arranged for supporting a resonator optical  
13 mode, the resonator being positioned so that the resonator evanescently optically  
14 couples with the transmission optical waveguide coupling segment;
- 15 d. an optical modulator, the optical modulator positioned on and secured to the alignment  
16 housing, the optical modulator being evanescently optically coupled with the resonator;
- 17 e. a modulator controller, the modulator controller being operatively coupled to the optical  
18 modulator for modulating, in response to an applied control signal, at least one of:
- 19 i) a level of optical power transfer through the evanescent optical coupling between  
20 the resonator and the optical modulator;
- 21 ii) a level of optical loss of the optical modulator; and
- 22 iii) a resonant frequency of the optical modulator

23 thereby enabling controlled modulation of a coupling condition between the transmission  
24 optical waveguide and the resonator; and,

- 25 f. the waveguide-alignment groove and the resonator-alignment groove being arranged so  
26 as to reproducibly establish and stably maintain evanescent optical coupling between  
27 the transmission optical waveguide and the resonator and wherein the alignment  
28 housing reproducibly establishes and stably maintains evanescent optical coupling  
29 between the resonator and the optical modulator.

- 1    2.    The resonant optical modulator assembly of Claim 1 wherein the resonator includes a  
2        plurality of fiber-ring resonator segments, at least two of which resonator segments are  
3        evanescently optically coupled together.
- 4    3.    The resonant optical modulator assembly of Claim 1 wherein the waveguide alignment  
5        groove has an enlarged central portion, thereby enabling heating and pulling of an optical  
6        fiber positioned within the waveguide-alignment groove to form a fiber optic taper segment  
7        while substantially reducing contact between the alignment housing and the fiber-optic-taper  
8        segment.
- 9    4.    The resonant optical modulator assembly of Claim 1 wherein the transmission optical  
10       waveguide comprises a transmission fiber optic waveguide, the evanescent optical coupling  
11       segment of the transmission fiber optic waveguide comprises a fiber-optic-taper segment,  
12       and the fiber-optic-taper segment is partially wrapped around a portion of an outer  
13       circumference of at least one of the fiber-ring resonators.
- 14   5.    The resonant optical modulator assembly of Claim 4 further including a wrapping adjuster,  
15       the wrapping adjuster being arranged so as to modify the spatial extent of the wrapped  
16       portion of the outer circumference of the fiber-ring resonator by the transmission fiber optic  
17       waveguide evanescent optical coupling segment, thereby enabling adjustment of the level of  
18       evanescent optical coupling between the transmission fiber optic waveguide and the fiber-  
19       ring resonator.
- 20   6.    The resonant optical modulator assembly of Claim 5, wherein the alignment housing is  
21       further arranged for engaging the fiber-optic-taper segment and holding the fiber-optic-taper  
22       segment in a partially wrapped engagement around the fiber-ring resonator, the taper  
23       segment support members being positioned on the alignment housing with the resonator  
24       alignment groove therebetween.
- 25   7.    A method for assembling a resonant optical modulator comprising the steps of:  
26       a.    positioning a fiber optic waveguide within a waveguide alignment groove in an  
27           alignment housing and securing the waveguide to the alignment groove;  
28       b.    positioning a resonator within a resonator alignment groove in on alignment housing  
29           and securing the resonator to the alignment groove;

- c. positioning and securing an optical modulator on the alignment housing, the optical modulator being operatively coupled to the resonator; and
    - d. operatively coupling a modulator controller to the optical modulator.
8. A resonant optical filter assembly for an optical WDM system, comprising:
  - a. an alignment housing including a first waveguide-alignment groove, a second waveguide-alignment groove, and a resonator-alignment groove;
  - b. a first transmission optical waveguide, the first waveguide being positioned within the first waveguide-alignment groove and secured to the alignment housing, and arranged for transmitting therethrough a plurality of optical signals, each carried by a respective waveguide optical mode corresponding to an optical channel of the WDM system, the first transmission optical waveguide having an evanescent optical coupling segment with an evanescent portion of each waveguide optical mode extending transversely beyond a surface of the evanescent optical coupling segment;
  - c. a second transmission optical waveguide, the second waveguide being positioned within the second waveguide-alignment groove and secured to the alignment housing, and arranged for transmitting therethrough a plurality of optical signals, each carried by a respective waveguide optical mode corresponding to an optical channel of the WDM system, the second transmission optical waveguide having an evanescent optical coupling segment with an evanescent portion of the waveguide optical mode extending transversely beyond a surface of the evanescent optical coupling segment; and,
  - d. a resonator, the resonator being positioned within the resonator-alignment groove and secured to the alignment housing, and arranged for supporting a resonant optical mode, the resonator being positioned so as to be evanescently optically coupled to the first transmission optical waveguide coupling segment and the second transmission optical waveguide coupling segment.
9. The resonant optical filter assembly of Claim 8, wherein the resonant optical filter assembly is an optical WDM slicer/interleaver.
10. The resonant optical filter assembly of Claim 8, wherein the resonant optical filter is an optical channel add/drop filter.

- 1 11. The resonant optical filter assembly of Claim 8, wherein the first and second waveguides are  
2 fiber optic waveguides and the evanescent optical coupling segments includes fiber-optic-  
3 taper segments, and wherein at least one of the first and second waveguide-alignment  
4 grooves has an enlarged central portion, thereby enabling heating and pulling of an optical  
5 fiber positioned within the centrally-enlarged waveguide-alignment groove to form the  
6 fiber-optic-taper segment of the respective waveguide while substantially reducing contact  
7 between the alignment housing and the respective fiber-optic-taper segment.
- 8 12. A method for assembling a resonant optical filter assembly comprising the steps of:  
9 a. positioning a first waveguide within a first waveguide-alignment groove on an  
10 alignment housing and securing the first waveguide to the alignment housing;  
11 b. positioning a second waveguide within a second waveguide-alignment groove on an  
12 alignment housing and securing the second waveguide to the alignment housing; and,  
13 c. positioning the resonator within a resonator-alignment groove on an alignment housing  
14 and securing the resonator to the alignment housing.  
15